Keeping things in perspective

KEEPING THINGS IN PERSPECTIVE[1]

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forthcoming in *Philosophical Studies*

Abstract: Scientific realism holds that scientific representations are utterly objective. They describe the way the world is, independent of any point of view. In *Scientific Representation*, van Fraassen argues otherwise. If science is to afford an understanding of nature, it must be grounded in evidence. Since evidence is perspectival, science cannot vindicate its claims using only utterly objective representations. For science to do its job, it must involve perspectival representations. I explicate this argument and show its power.

Keywords: Objectivity, Representation, Van Fraassen, Perspective, Empirical science

Realism is probably our default metaphysical stance. The most obvious explanation of the world's manifest resistance to the will is that the world consists of facts that are independent of the ways rational agents think or feel or act. We quickly realize that wholesale realism won't do. The fact that Mark is now drinking coffee and the fact that he hopes it won't rain are directly dependent on his thoughts, feelings, and/or actions. The fact that bell-bottoms are in style depends on what people think and feel, even if not on what any particular person thinks or feels. The fact that that the Red Sox won the game and the fact that giving to charity is good depend on human institutions and practices. Under pressure from such challenges, we retreat from our naive realist stance. Not all truths, we concede, are made true by the mind-independent world. But, we tend to retreat reluctantly, ceding ground only when we must.

Scientific realism is where many hold the line. Natural science is rigorous. It does not use vague terms like 'game' or 'charity'; it does not depend on shifting standards, as stylishness does. It takes the natural order as its subject matter – an order that for the most part is as it is regardless of human artifacts, practices, and institutions. Even when natural science investigates human beings, it describes or represents them in the same neutral way it describes or represents any other organism. Science discovers things about nature – things that were there all along, most of which would have been there if rational organisms had never evolved. Natural science apparently is, in Bernard William's apt phrase, about what is there *anyway* (1978).

Moreover, science has been stunningly effective at providing an understanding of its topic. No other approach even comes close. It may seem reasonable then to think that science represents the way the world is, that at least in the ideal end of inquiry it will (would?) do so completely and without bias or distortion, and that current science approximates the ideal. If so, scientific representations must be *utterly objective*. That is, they must not depend essentially on users or potential users with distinctive interests and points of view. The semantics of such representations then are independent of and logically prior to their pragmatics.

The term 'utterly objective' is mine. To block misinterpretations, I should offer an explication. A *representation* is a putatively denoting symbol. It conveys how things are or could be. Among the familiar sorts of representation are verbal descriptions, mathematical equations, pictures, diagrams and maps. Such symbols need not actually denote; their semantic kind is determined by their being the sort of symbol that could, if the world obliged, denote. 'Phlogiston' is as much a denoting symbol as 'oxygen' is. In one sense, any representation depends on users or potential users with distinctive interests and points of view. Something would not be a representation unless it was used or could be used to represent, and it would not be a representation of a particular thing unless it was used or could be used to represent that very thing. There would be no representation of a particular item if no one had interests that would be served by producing one. The sentence 'Tibet is mountainous' would not represent the topography of a particular geographical region if speakers did not call a particular bit of land 'Tibet' and did not call a particular sort of terrain 'mountainous'. But the choice to correlate particular labels with particular referents is effectively arbitrary. The very same information would have been conveyed by the sentence 'Murble is morbish' if 'Murble' had been the English word for Tibet and 'morbish' the English word for mountainous. The user-independence required for utter objectivity is independence except for the making of such arbitrary choices. The contention that scientific representations are utterly objective is a contention that beyond arbitrary choices, they exhibit no dependence on users or potential users.

The term 'scientific realism' encompasses a variety of positions with a common set of core commitments. For the purposes of this paper, I shall take scientific realism to be committed to at least the following: (a) the entities that an ideal science, literally construed, quantifies over actually exist; (b) the laws of an ideal science are literally true and utterly objective; (c) the models in an ideal science represent their targets accurately, and without bias or distortion; and (d) mature sciences approximate the ideal. Although the representations in a mature, but not ideal, science may not be exactly true, they too are utterly objective. Conditions (a), (b), and (d) are drawn from Hilary Putnam (1978). Condition (c) is added to accommodate both semantic views which take a theory to be a collection of models (van Fraassen, 1980), and syntactic views which take models to mediate between laws and the phenomena they pertain to (Morgan and Morrison, 1999). The first three conditions are supposed to capture the idea that science represents the way the world is anyway. The fourth condition is supposed to connect actual, contemporary science with the ideal.

As is well known, Bas van Fraassen rejects scientific realism. In *The Scientific Image* (1980) he argues for constructive empiricism, a position that contends that science seeks not truth but empirical adequacy, where the standard of empirical adequacy is truth about observables. Part I of *Scientific Representation* (2008) contains a different challenge to scientific realism, one that contends that if scientific representations – models, equations, maps, graphs, etc. – are to perform their scientific functions, they cannot be utterly objective. Nancy Cartwright (1983) makes similar arguments about particular scientific models. Like van Fraassen, she regards this feature not as a defect in the models but as an insight into the sort of epistemic access they supply. The argument I find in *Scientific Representation* runs deeper. It is not just that this or that model, or models in this or that science are insusceptible of utter objectivity. Rather, it is that in order to afford the sort of understanding of nature that it does, science cannot consist exclusively, or predominantly, of utterly objective representations. Science as we know it must deploy perspectival representations.

The argument is not an argument against realism per se; it is an argument against interpretations that construe certain representational devices, as they are used in science, as utterly objective. Since such devices are central to science, if utter objectivity of its representations required for realism, the argument is an argument against *scientific* realism. The scientific realist might, of course, rescind the commitment to utter objectivity. But to admit that scientific representations are inevitably perspectival would undercut the claim that (ideal) natural science discloses what is there anyway. It would thereby significantly undercut the attractiveness of scientific realism. The argument then is that science, as currently practiced, or foreseeably improved, is not the mirror of nature.

Two questions immediately arise: How could scientific representations be perspectival? And why must many of them be perspectival? The burden of this paper is to sketch van Fraassen's answers these questions, and to show why his answers should make us reconsider our views about what science does and how it does it.

Getting Perspective

Linear perspective is a miracle of Western art. First described by Alberti (1972), it is a method for representing spacial depth on a flat surface. Lines orthogonal to the picture plane converge at the vanishing point, and the depicted sizes of objects are proportional to their actual size and to their ostensible distance from the viewer. The pictorial effectiveness of linear perspective in works like Raphael's *School of Athens* is obviously of great aesthetic interest. Van Fraassen maintains that linear perspective should be of equally great interest to philosophy of science. For with the development of projective geometry, it became possible to prove that properly drawn linear perspective representations are rigorous geometric projections. Because cross-ratios are invariant across changes in orientation and origin, drawings in perspective convey objective information about constancies in the appearances items present from different points of view. They are not utterly objective though, for they still depend on points of view. Perspective drawings are indexical: they represent how things look from *here* (for some value of 'here'.) But their indexicality does not make them subjective. Cross-ratios are determinate matters of fact about projective relations, not mere matters of opinion. Van Fraassen (2008, pp. 64-66) concludes that a linear perspective drawing of an actual scene is a measurement, a mapping.

There are inherent limitations on what any single representation can represent. Every representation is a product of selection. The representer has to choose what to represent, what aspects of the represented item to capture in the representation, and what level of detail to represent. Despite the fact that these are matters of choice, when it comes to scientific representations, it is possible to make mistakes. Simpson's paradox arises because fine grained statistical regularities are obscured at a coarser grain. Although the pattern of graduate admissions across the university at one point suggested that Berkeley discriminates against women, the admissions patterns of each graduate department indicated the contrary. To settle the issue requires knowing which statistics to use (Cartwright, p. 37). To use a coarse grained representation to answer questions that require a finer grain is to make a mistake, even if all the features displayed in the coarse grained representation actually obtain.

Because they depend on a specific origin and orientation, perspective drawings have further limitations. From a given vantage point, one object may *occlude* another. If the horse is behind the barn from the picture's point of view, then the picture's representing the barn precludes its representing the horse. Nor is this always a matter of big things occluding little ones. If the mouse is close to the picture plane and the barn is far from it, the perspectival representation of the mouse may occlude the barn. A representation is *implicitly non-committal* with respect to a property if it makes no commitment as to whether the represented object has that property. A stick figure is implicitly non-committal with respect to its subject's girth. It simply does not go into the matter. A representation is *explicitly non-committal* with respect to a given property if its representing the having of one feature precludes its taking a stand on the having or lacking of another. A representation of a man wearing a hat is explicitly non-committal with respect to whether he is bald, because representing him as hatted makes it impossible for the picture to commit itself on the question of his baldness. To be sure, the horse, the girth, and the hairline could be represented in a perspective drawing. But to represent the horse requires removing the barn or changing the perspective. To represent the girth requires a more rounded figure. To be committal with respect to the man's baldness requires omitting the hat.

Indexicality, occlusion, and non-commitment do not either severally or jointly entail that there are things that cannot in principle be represented perspectivally. They entail limitations on what a single perspectival representation can represent. But because of these limitations, there cannot be a single, comprehensive perspectival representation that represents everything from a single point of view. The 'God's eye view' cannot be a point of view.

The pictures painted by Renaissance artists are, of course, of (putatively) visible objects, and the space they (purport to) represent is (putatively) physical space.[2] These restrictions are philosophically incidental. Early perspective drawings had only one vanishing point. But it is straightforward to create works with multiple vanishing points. *Le Déjuner sur l'Herbe*, for example, is in two-point perspective. Thus the number of vanishing points is optional. Features at higher levels of abstraction than size, shape, and distance can be represented perspectivally, if the requisite structural relations are preserved. So the restriction to visible features is optional as well. Nor need the space be physical. A logical space is a multi-dimensional array of possibilities open to the items that occupy the space. To locate an item in a logical space is to determine which of the possibilities defined by that space it realizes. To represent an item in a logical space is to represent it as having a particular position in the array of possibilities the space marks out. Representations in a logical space, like representations in a physical space, can be perspectival. They can show how occupants of that space appear from a certain vantage point. And they can do so with no loss of rigor. For the remainder of the paper I will take the term 'perspectival' to refer to any representation that represents how things appear from a particular point of view.

With the restrictions to physical space and visible features lifted, it is evident that science could avail itself of perspectival representations. It could generate and deploy a host of perspectival drawings, diagrams, scale models, and maps. There is plenty of evidence that it does so. Still, one might think, only overtly pictorial or diagrammatic representations – the picture of the harmonic oscillator, the diagram of the double helix, the tinker toy model of the protein – could be perspectival. Many scientific representations are mathematical models – systems of equations. It is, one might think, hard to imagine how any extrapolation from linear perspective could characterize to them. This may suggest that the visual models that admit of a perspectival interpretation are mere heuristics. They are visual aids that help us imagine the phenomena, but not essential elements of science. The mathematical laws and models – the equations – are the true scientific representations, and they are utterly objective.

Things are not so simple. Analytic geometry, provides the resources to interpret geometry algebraically. Geometric truths are provably equivalent to algebraic ones. Contemporary Cartesian geometry demonstrates that equivalence goes both ways (van Fraassen, 2008, p. 41). Algebraic truths are mathematically equivalent to geometric ones. In effect, if we define an appropriate space, pretty much everything we can characterize mathematically can be spatialized. Indeed, we do not even need to do the reduction. The equivalence shows that the equations themselves, whatever their ostensible form, are construable as spatial representations. To be sure, the space need not be three dimensional physical space. All that is needed is that there is an n-dimensional space of alternatives which embeds the mathematical model. Nor, of course, does this show that the spatialized representations are perspectival. But the mere fact that they are presented as equations provides no reason construe mathematical models as non-perspectival. In principle then equations are as capable as pictures and diagrams of bearing a perspectival interpretation.

Recapitulation: Although I have made some headway, it is important to emphasize how little I have done so far. I have not shown that scientific representations must be perspectival, or even that any of them are perspectival. All I have shown is that there is nothing in the nature of perspectival representation that precludes scientific representations' being perspectival. If my argument so far is successful, it answers the question 'How could scientific representations be perspectival?' It remains to answer the question 'Why must many of them be perspectival?' It is to that question that I now turn.

The View from Nowhere

Plainly, not all pictorial or diagrammatic representations are perspectival, even in the extended sense in which I am using the term. The Cartesian co-ordinate system provides a familiar and elegant framework for non-perspectival representations. Cartesian representations have no vanishing points; parallel lines in every dimension remain parallel. Although Cartesian representations locate represented objects by reference to an origin and a direction, the choice of origin and direction are arbitrary. 'The chosen frames of reference, the co-ordinate systems, are inessential to the geometry taken in and by itself' (van Fraassen 2008, p. 69). Such representations are not indexical. One need not locate oneself in the space of the representation to understand what and how it represents. The representational powers of Cartesian systems are not limited by occlusion or explicit non-commitment. Rousseau's picture of a tiger 'is explicitly non-committal about the [number of the] tiger's stripes, because it represents the tiger as obscured by leaves, and this precludes it from representing all the tiger's stripes' (Lopes, 1996, 118-119). A Cartesian representation, though it would not look like a tiger, could easily circumvent the difficulty. Let the *x*-axis represent stripes, and the *y*-axis represent leaves in the environment. The only available positions are integer values along either axis. Then where a stripe is not obscured by leaves, $y=0$; where it is overlapped by leaves $y>0$, with the value of y indicating the number of leaves overlapping a particular stripe. Where there are leaves but no stripes, $x=0$. Such a graph indicates the overlap of stripes by leaves, but nothing is occluded. It is expressly committed to the number of stripes on the tiger, regardless of their relation to leaves.

Why shouldn't we think of the logical spaces of scientific representations as Cartesian spaces? Then, aside from the few scientific representations that are expressly perspectival, we could construe scientific representations as utterly objective. The mathematical models could be spatialized – we could represent them in a Cartesian co-ordinate system – but the results would still be utterly objective. There would be no reason to deny that they represent the way the world is anyway.

It is undeniable that science can generate Cartesian representations. It is undeniable that such representations as likely to be accurate and adequate to their subject matters as any other representations we might produce. So we have every reason to consider them utterly objective. In the limit, if not now, they will embody perspectiveless information about the way the world is anyway. The fact that science *could* generate perspectival representations, and *could* interpret extant representations perspectivally gives us no reason to think that it *does* or that it *should*.

This is so, if science's function is merely to mirror nature. The claims of ideal science could bear an interpretation under which they reveal how things are anyway. But, van Fraassen argues, such a construal does not do justice to science, for accuracy and adequacy to the subject matter are not enough.

The View from Somewhere

Science is not something that just happens to us, it is something we do. To do it, we need to use scientific representations. 'Use' is a pragmatic matter; and to make use of anything a subject needs to properly locate herself with respect to it. This is evident in the relation between science and technology. To develop an alloy that resists metal fatigue, a metallurgist has to be able to recognize signs of metal fatigue. To do that she must adopt a perspective from which she can discern metal fatigue if it is present. This will not, of course, be a matter of merely looking at distressed samples. It will involve measurements, many of them made with technologically complex measuring devices. These put her in a position to say, 'This is how metal fatigue (or its absence) looks from here'. Assuming she is scrupulous, she will run a series of tests which yield different perspectives on the phenomena. She will check one appearance against another, drawing her conclusion from what she observes from a variety of points of view. She does not, because she cannot, solve her problem using the view from nowhere. For she has to know how metal fatigue is manifested.

This point must be conceded but, one might snobbishly sneer, that's just a point about technology, not about pure science. It is to be expected that when we put something to use we need to adopt a perspective. But, to continue the sneer, science is not technology. Pure science may be utterly objective even though technological applications cannot be.

Van Fraassen points out, however, scientific results are established by testing and experimentation, and they are in principle always open to further testing. Testing is as indexical and perspectival as technological applications. If one wants to ascertain whether semi-conductors operate in a magnetic field, one must run a series of experiments and take measurements. To design the proper experiments and take the proper measurements, one must adopt a perspective on the phenomena – one must figure out how the phenomena would present themselves under various circumstances, how they would look from various points of view. Indeed, the distinction between testing and technology is spurious, since the testing devices are products of technology, and every technological application is in principle a test. Even as simple a measuring device as a tape measure owes its status to considered judgments about the appearances things present – e.g., that the items a tape measure measures are not affected by the fact that they are being measured, hence that something that measures 32 cm is a reliable indication that it is 32 cm.

Van Fraassen's argument then is this: science affords epistemic access to nature. That access is achieved through experimentation and measurement. The only way for an observer to perform the experiments or make the measurements is to locate herself in the logical space of the phenomena, so her stance is indexical. She has to think, 'If *m* is going on, these are the appearances it will present under these test conditions.' That is, if *m* is going on, this is how it will look from here. This locates the observer in the logical space she is evaluating, it affords a perspective on how things should look from here (for some value of 'here').

Although one could take the representations produced by science as utterly objective, doing so would divorce them from the empirical methods that generate and confirm them. In that case, however, science would provide no reason to believe or accept them. To interpret the repesentations as utterly objective is to cease to consider them scientific. For science to do its epistemic job, it requires measurement. Measurement is always indexical and perspectival. Hence for science to do its epistemic job, it must involve indexical, perspectival representations.

Conclusion

To be testable, science must use representations that are perspectival. Those representations are objective in that they contain information that is invariant across representations of the same object. They are testable in that multiple representations of the same objects from the same perspective yield equivalent information, and in that that information can be accessed from multiple perspectives. But they cannot plausibly be construed as embodying the view from nowhere or the way the world is anyway. They are not utterly objective.

The argument I have sketched does not discredit realism as such. One could still endorse realism on purely metaphysical grounds. Indeed, one could even endorse realism about the contents of scientific theories on metaphysical grounds. The argument only shows that science –

the enterprise that scientists engage in – cannot underwrite such an endorsement. Nor does the argument favor constructive empiricism over other non-realist construals of science. It is, for example, equally congenial to a constructivism that considers unobservables like electrons and quarks as real as observables like birds and bees, and that considers a theory that quantifies over electrons and quarks to be as committed to their existence as a theory that quantifies over birds and bees is committed to theirs. So plenty of problems in the philosophy of science remain to be solved.

The argument underscores something that may be, but should not be, surprising. Science is a human achievement – a product of human endeavor. As such, it is ineluctably connected to the ways we access the world. Science is one of the humanities.

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1 I would like to thank James Tappenden, Mary Kate McGowan, Catherine Wearing and Bas van Fraassen for useful comments on an earlier version of this paper.

2 I say 'purportedly' and 'putatively' because some of the pictures have religious subjects. I am not remotely qualified to say whether heaven, if it exists, is three dimensional, or whether angels, if they exist are visible. But it is plain that the artists represented heaven as a three dimensional physical space, and angels as visible entities in such a space.

References

Alberti, Leon Battista. (1972): *On Painting and On Sculpture*, London: Phaidon Press.

Cartwright, Nancy. (1983): *How the Laws of Physics Lie*, Oxford: Clarendon Press.

Lopes, Dominic. (1996): *Understanding Pictures*, Oxford: Clarendon Press.

Morgan, Mary and Margaret Morrison, eds. (1999): *Models as Mediators*, Cambridge: Cambridge University Press.

Putnam, Hilary. (1978): *Meaning and the Moral Sciences*, London: Routledge and Kegan Paul.

van Fraassen, Bas. (2008): *Scientific Representation: Paradoxes of Perspective*, Oxford: Oxford University Press.

van Fraassen, Bas (1980): *The Scientific Image*, Oxford: Clarendon Press.

Williams, Bernard. (1978): *Descartes: The Project of Pure Enquiry*, Harmondsworth: Penguin Press.